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NUTRITION— the Armor of Robust Health

THE responsibility of public agencies is to see to it that all people know about the startling new facts in nutritional science and that these facts can play an important part in keeping their family's health high and their spirits up no matter what the drain of defense work on their home and life.

These two scientific papers are reprinted at the request of the National Nutrition Advisory Committee.

They touch on the broader aspects of the entire nutritional front, as well as dealing specifically with one of the first important steps of that program.

M. L. WILSON, *Chairman,*
The Nutrition Advisory Committee
to the Coordinator of Health, Welfare,
and Related Defense Activities.

*Enriched Flour and Enriched Bread: How it Started**

RUSSELL M. WILDER
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THE BASIS of this story is the news release, dated January 29, 1941, of the National Research Council, in which announcement was made of the recommendation of its Committee on Food and Nutrition of enriched flour and enriched bread. The news release you have already seen. The story back of it is what I want to tell today.

The National Research Council's Committee on Food and Nutrition

RUSSELL M. WILDER, M.D., Ph.D., is one of the famed scientists whose achievements in medicine were recently honored in the book, "Physicians of the Mayo Clinic." After a brilliant practicing and teaching career Dr. Wilder, in company with Dr. Ray Williams and other co-workers at the Mayo Clinic, conducted a nutritional experiment that has led to an increasing appreciation of the need for thiamine (Vitamin B₁) in every-day diets. Despite his heavy duties as Professor of Medicine and Chief of the Department of Medicine at the Mayo Foundation, a position he has held since 1931, Dr. Wilder has devoted increasing time and intensified work towards raising the standards of national nutrition. He is Chairman of the Committee on Food and Nutrition of the National Research Council and a member of the Nutrition Advisory Committee to the Coordinator of Health, Welfare and Related Defense Activities.

was organized at the request of the government to provide scientific guidance for a national nutrition campaign. The committee will be studying many important groups of food and the contribution made by them to an adequate diet. It recognized, however, that wheat flour and its products demanded consideration before any other class of food, if for no other reason than that wheat flour and its products contribute more calories to the American diet than any other class of food. Foods such as sugar, milk, cornmeal, edible fats and meat will receive attention in due time. Improving the food ways of a nation of one hundred and thirty million people is a large undertaking.

The vitamins and minerals of wheat

SOME PHYSICIANS and many others have criticized white flour and white bread for more than a hundred years. The early critics, among them Sylvester Graham, for whom graham bread was named, were mostly fad-dists who had little reason and no scientific grounds for their objections, but the situation now is different. Since the advent of what may be called "the vitamin era" the demand

*Read at the conference of bakers, millers and others to co-ordinate the introduction of enriched flour and enriched bread, Chicago, March 5, 1941.

for flour with better nutritional qualities has acquired formidable scientific backing. Dr. R. R. Williams issued a warning not long ago, published in "Cereal Chemistry": "To blink at these scientific facts," he said, "which will presently become common knowledge, would be suicidal for the commercial enterprises concerned." If such a statement can be justified, enrichment of flour and bread with vitamins and minerals, as now is proposed, represents a move not only in the interest of better public health for which it was intended, but also in the interest of the milling and baking industries.

The significance of the vitamin content of wheat first came to light in 1916 when McCollum and his co-workers reported on the presence in wheat germ of an antineuritic substance which they called water-soluble vitamin B. Published a few years later was a classic study by Osborne and Mendel on the nutritive value of the wheat grain. They pointed out that the wheat berry consists of about 83.5 per cent endosperm (the white starchy content of the berry), 1.5 per cent embryo or germ, and 15 per cent bran and inner coatings. The embryo they found to be rich in the water-soluble vitamin B, but this also was present in the bran and even in small amounts in the endosperm. Their article raised questions about milling methods, and interest in milling was further aroused in 1922 by a scientific paper of Bell and Mendel. It was revealed that while the wheat germ

is rich in vitamin B, the germ constitutes so small a part of the berry as a whole that its contribution to the total B content of the berry is only about 15 per cent. Wheat from which the germ had been removed by dissection still contained much of this vitamin. The patent white flour, which represents the extraction of from 60 to 70 per cent of the berry, accounted for only 10 per cent. The rest was in the bran and inner coatings, which with the germ are removed in the manufacture of white flour. Other scientists corroborated these observations and showed that nutrients other than the antineuritic vitamin also are more concentrated in parts of the grain removed in milling.

The antineuritic substance which McCollum, Mendel and their co-workers called water-soluble vitamin B has since been shown to consist of a number of vitamins, so that today this substance is referred to commonly as the vitamin B complex. In it are thiamine, also called vitamin B₁, riboflavin or vitamin B₂, nicotinic acid, which has not been given a number, pantothenic acid, also not numbered, pyridoxine or vitamin B₆, choline and others. Of these, thiamine, nicotinic acid and riboflavin play a part in the formation in the body of enzymes necessary for the smooth oxidation of sugar, so that eating starchy foods such as flour, which by digestion is converted into sugar, creates an increased demand for them. This important knowledge has been obtained only recently from re-

search conducted in numerous laboratories of biochemistry.

There are now available many reports of the thiamine (vitamin B₁) content of wheat. It varies considerably with locality, soil and weather conditions. Soft wheats, for example, contain less, as a rule, than hard wheats. The analyses of Booher and Hartzler, for instance, with which other reported data are in harmony, showed for soft winter wheat a content of thiamine representing about 1.6 mg. per pound (0.354 mg. for each 100 gm.), and for hard spring wheat 2.38 mg. per pound (0.525 mg. for each 100 gm.). A milligram (mg.) of thiamine represents 333 International units of vitamin B₁.

Other nutrients in the wheat berry which have received consideration in recent discussions of flour and bread are dl-alpha tocopherol, commonly known as vitamin E—found only in the germ but of doubtful importance in human nutrition—and a number of minerals including iron, calcium and phosphorus. Whole wheat flour, according to recent studies, is a good food source of iron and phosphorus and contains significant amounts of calcium, whereas plain white flour is a poor source of all the vitamins and of most of the minerals.

The nutrition problem

YOU MAY be asking now about what this has to do with the public health, and whether the use of plain white flour and its products

contributes at all importantly to the nutrition problem, granting there is such a problem.

When the story of the control of malnutrition can finally be told it may not be quite as dramatic a tale as that of the eradication of cholera and typhoid, but the advantages to the public health from such control will, in my opinion, match in importance what has been accomplished in sanitation. Typhoid either kills or ultimately relaxes its hold. Nutritional deficiency saps vitality in so insidious a way that the victim may be unaware that enough is wrong to call a doctor. A few persons die of beriberi in this country, but not many. A few die of pellagra, but even before it was learned that nicotinic acid could be curative in pellagra, the number of deaths recorded in any single year did not exceed four or five thousand. The milder degrees of nutritional deficiency, although they are neither fatal nor completely incapacitating, constitute the nub of the problem of malnutrition. They wreck courage. They undermine the will to do. They interfere with sleep, so that rest is disturbed. They seriously depress resistance to other diseases, and in women contribute to the occurrence of complications during pregnancy. The prevalence of milder degrees of malnutrition, in the opinion of those who are best informed, accounts for much of the shiftlessness of the poor whites of the South, and for a considerable part of the relief rolls. The undernourished are unable to hold jobs

if they find them; they become unemployable.

Sir John Orr, an English physician writing recently in the *British Medical Journal*, stated that improving the diet of workmen whose diets had not been up to standard had been "followed by increased output without any conscious effort and also by reduction in the number of accidents." He also referred to observations relating to mental alertness. "In some tests supplementary feeding of milk and other protective foods had been followed by definite improvement in the ability of previously undernourished children to learn, and in one such test the educational advance in a period of five months was equivalent to the advance usually made by these children in two years." Comparable improvement in learning capacity has been observed in a number of American schools after introducing the school lunch program.

Statements such as these may appear to you to be exaggerated. I myself demanded proof two years ago and got it. Since then Dr. Ray Williams with Dr. Mason and other associates, among whom I am happy to be numbered, has been engaged in studying effects produced on human subjects by the isolated restriction of thiamine (vitamin B₁). The scientific control maintained has been rigid. The subjects are housed in an isolated part of the hospital and remain continuously under the close supervision of a trained staff of nurses. The food given is analyzed for thiamine by Dr.

Mason, and a double check is obtained by regular analyses for thiamine of twenty-four hour collections of urine. The allowance of thiamine is regulated and changes in dosage are made without the knowledge of the subjects.

The degree of disability induced by withdrawing thiamine from the otherwise adequate diets of these persons was impressive. Fatigue appeared, interest in daily tasks was lost, accompanied by discouragement, depression and irritability. Appetite was lost. Multiple neurasthenic complaints were heard. The heart sounds became faint, the blood pressure fell, the pulse was irritable, and as the duration of the restriction was prolonged abnormalities in the action of the heart and the mobility of the stomach and intestine could be recorded with special apparatus. Likewise changes were noted in the chemical constituents of the blood, especially in the concentration in the blood of by-products in the oxidation or utilization in the body of sugar. These abnormalities were all quickly corrected when more thiamine was given. In the first of these studies the allowance of thiamine was restricted to less than 20 International units. Later, subjects were maintained on a level of intake of thiamine that was not much below what until very recently was considered nearly adequate. Translated into terms representing an equivalent intake for men eating 2500 to 3000 calories of food, the figure would be from 200 to 225 Interna-

tional units of vitamin B₁ (0.6 to 0.67 mg. of thiamine). This is an amount of thiamine as great as many persons receive in the foods they either elect to eat or take for lack of means to buy something better. In a survey conducted by the Rockefeller Health Board near Chapel Hill, North Carolina, the average intake for adult persons was 233 International units (0.699 mg. of thiamine). In the food purchase study made by Stiebeling and Phipard for families of employed wage earners and clerical workers in cities, the food contained less than 300 International units a day in 10 per cent of the families, and had allowance been made for loss in cooking and for waste the figure probably would be reduced to between 200 and 250 International units.

The results of the later studies of Williams show that people can live for six months or more on such a low intake of thiamine, without the development of abnormalities detectable with laboratory methods of examination. But there is a development of the symptoms I related before, and for passable health an intake at least twice as great, or in the neighborhood of 500 International units (1.66 mg. of thiamine) is necessary. The reports of Williams have confirmed and amplified earlier observations of Jolliffe and others.

Gross lack of any of the vitamins and for that matter of any important nutritional factor in food, gives rise to clearly recognizable disease, but as with thiamine, an intake of any vitamin or mineral which is only on the

borderline of adequacy and provides no factor of safety is likely to lead to poor health. Reserves are necessary to meet increased requirements created by unusual exertion, complicating disease, pregnancy, lactation and other stresses to which men or women are exposed. The most reliable index of the extent of malnutrition in the United States is provided by the Stiebeling and Phipard report to which I referred. It showed that only about a fourth of the twenty-nine million non-relief families in America were purchasing food which provided diets that could be regarded as good, that more than a third or more had diets classed as poor.

You may question conclusions based on surveys, but before you reject these data please consider (1) that the standards of reference adopted by Stiebeling and Phipard were low in several particulars, as compared to the standards which are proposed by the Committee on Food and Nutrition of the National Research Council, and (2) that the income of two-thirds of the families of the United States, as reported by the Federal Bureau of Labor Statistics, is less than \$1500, with an average for this two-thirds of only \$826—\$17.25 a week per family, for housing, fuel, light, clothing and food. Of such an income the amount available for food is not more than \$8.75. It is possible to supply a very adequate diet on a budget of \$1.75 per capita per week, which for a family of five persons would represent \$8.75 but to do so you must depend on inexpensive

foods. This means including in the diet relatively much flour and bread, and the flour and bread until we had enriched flour had to be of whole wheat. Most people, however, use plain white flour, and recent analyses by Stiebeling of the quality of diets obtained by city families in the North and West revealed poor diets in 75 per cent of families spending \$1.75 per person per week.

However, all malnutrition is not confined to families of low income groups. The children of the rich often indulge excessively in the tempting confections of the candy merchant to their detriment. The sons and daughters of the well-to-do in many schools and universities, while receiving excellent classroom instruction in science, eat most unscientifically in boarding houses, fraternities and sororities. Evidence of the ill-effect of malnutrition on school performance has been presented. Also women frequently attempt to reduce themselves with no thought of possible injury to their nervous mechanisms, and business executives, getting paunchy, cut down on food without taking sufficient care about what can be cut without harm. Even liberal expenditures for food do not guarantee adequate diets. The analyses by Steibeling of the quality of diets obtained by city families in the North and West revealed poor diets in 5 per cent and only fair diets in another 25 per cent of families spending per person per week \$4.55.

The problem of malnutrition is not

new, but as we meet it today a difference is apparent. Two generations and more ago food might be scarce and limited in variety, but all of what there was would be taken in a natural form and carry with it vitamins and minerals. Also there was much resort in former days to "pot licker," with which many of you city bred folks have no familiarity. In the spring there were fresh green things, sulphur and molasses and other simple remedies for what may have been a mild dietary deficiency. Since those days the American diet has undergone a subtle change. Half of its calories formerly were provided by undermilled cereals, mainly as coarsely ground flour. This half has been replaced by less nutritive food. In part the replacement has been by roller milled white flour, which carries at most a sixth and usually less than a tenth of the thiamine and other vitamins that accompanied flour obtained by the more primitive milling methods of the past. In part the replacement has been by sugar, which carries no vitamins at all. To some extent this change has been compensated for by a greater consumption of garden vegetables and a greater consumption of milk, but unfortunately neither garden vegetables nor milk are very good sources of thiamine. They probably also are poor in nicotinic acid. Furthermore, being more costly, at least for the city dweller, garden vegetables and milk have gone disproportionately to families in the upper income groups, leaving the economically less fortunate

much more poorly nourished than they ever were. Sir John Orr and David Lubrock, in their book entitled "Feeding the People in War Time," published last March, related the deterioration of the diet of the working class in England in the nineteenth century to the rise of industrialism. "The diet came to consist more and more of the cheapest form of energy supplier, and by the time of the Boer War the required height for recruits for the Army had to be lowered from 5 feet 3 inches to 5 feet. It previously had been reduced from 5 feet 6 inches to 5 feet 3 inches. Since then improvement has been noted."

From theory to action

INDIVIDUAL MILLERS and bakers, conscious that all was not right, have been experimenting for several years with fortification of flour and bread, adding thiamine, and in some instances other vitamins and minerals. Also much discussion of the subject has been heard in scientific circles. On December 9, 1938, a co-operative committee on vitamins of the Councils on Food and Nutrition and Pharmacy and Chemistry of the American Medical Association gave expression to certain principles relating to food processing in general. These principles as formulated and adopted by the Council on Foods and Nutrition March 18, 1939 were: (1) that in the processing of foods every effort should be directed to retaining in the products the food values of the natural foods from which they were

made, and (2) that if the processed foods are not nutritionally equivalent to the original foods from which they are obtained, it is in the interest of the public to restore dietary essentials removed in processing so that these foods may have the full nutritive value of the natural foods with respect to the substances restored or added.

In this manipulation of processed foods it was considered essential (1) that the materials added be restricted to those for which greater distribution was in the interest of public health, and (2) that the food should be a suitable vehicle for the minerals and vitamins to be restored. The added substances should mix well and not lose potency during the usual conditions of storage. They also should be in such form as to be available biologically to the consumer.

The Council considered that white flour represented a processed food which, while valuable in itself as an inexpensive source of starch and protein, could be nutritionally improved by adding to it certain substances removed from it in milling. Substances which could be added advantageously would be thiamine, riboflavin, nicotinic acid, iron and possibly calcium and phosphorus. All of these are available in suitable form.

In the interest of public health, improvement of the inexpensive staple foods was primary in importance, and what was done should be effected at a minimal added cost to the consumer. Otherwise added vitamins or minerals

will not reach those who are most in need of them.

The aim in restorative fortification of foods was not to reach some hypothetical goal which had no bearing on the problem of human nutrition. It was to provide dietary essentials which people must get from their foods in order to maintain good health. The restored foods should make it easier for the person unskilled or unversed in nutrition to obtain the vitamins and minerals he ought to obtain with his food.

The principle of restoration to natural levels, as sponsored by the Councils of the American Medical Association, represented essentially fortification with a limit. Under this plan white flour would require addition to it of thiamine, nicotinic acid, riboflavin, iron, calcium and phosphorus in amounts sufficient to bring up the levels of these to their respective levels in whole wheat. The addition of thiamine was considered most important for most American diets, although under certain circumstances when meat and milk are not readily available riboflavin, nicotinic acid and calcium may assume as great an importance. It was not supposed that such a restored flour would be superior or even equal nutritionally to whole grain flour, but restoration to the degree proposed would go far. The Council recognized that although whole grain cereals might be preferable on theoretic grounds, an existing popular preference for white flour presented an extremely difficult, if not

an insurmountable, obstacle to widespread use either of whole grain products or of flour obtained by such a degree of undermilling as would be necessary to provide as much thiamine as was considered desirable. This preference of most of the public for white flour is based in part on the better keeping qualities of white flour, in part on the fact that the baking qualities of the better grades of white flour have been developed to a high state of perfection. A restored flour would provide the housewives and bakers with products of physical characteristics and baking qualities similar to those with which they had become accustomed.

Other discussion

THE FORTIFICATION of foods was made the subject of a symposium at the meeting in Toronto, April 26, 1939, of the American Institute of Nutrition. The discussion there was headed by Agnes Fay Morgan, Lydia J. Roberts, W. H. Sebrell, E. M. Nelson and Alonzo Taylor, all recognized as authorities in the science of nutrition. In general the principle of limited fortification was received with approval. In the meantime, at the request of the Council of Foods and Nutrition of the American Medical Association, Dr. Cowgill published in the Journal of the Association an exposition of the need for improving nutrition by adding vitamin B₁ to widely available accepted food. In this paper occurs the statement "It seems reasonable to believe that

through the one act of adding the vitamin (vitamin B₁) to the white flours as a group, we would increase directly the vitamin B₁ intake of a greater part of our population than could be effected by any other single step."

Interest in the problem also had been growing in England. It was stimulated by the war, and in June, 1940, the decision was reached by Parliament to fortify white flour in England with thiamin and calcium.* Likewise, in Canada, Dr. Frederick Tisdall, Chairman of the Committee on Nutrition of the Canadian Medical Association, and other nutrition experts, were promoting the use of "Melior" bread made with an under-milled flour.

Public hearings and conferences with Industry

THIS WAS the situation when the United States Food and Drug Administration, early in September, 1940, opened public hearings in Washington for establishing by regulation definitions and standards for flour. Representatives of the

millers and allied industries appeared, and testimony was introduced by them as to what vitamins and minerals and how much of each should be considered suitable as additions to flour. Other testimony placed in the record the recommendations of the Council on Foods and Nutrition of the American Medical Association. These recommendations in the meantime had been accepted informally by a subcommittee of the National Research Council's Committee on Medicine, a subcommittee which was advisory in matters relating to the Army and Navy rations. Everyone attending the hearings of the Food and Drug Administration seemed to want something done about adding vitamins and minerals to flour, but so little agreement existed as to what should be done that after many days a recess was ordered.

In the meantime, Mr. M. L. Wilson, Director of Extension Service in the Department of Agriculture, who had been named chairman of an interdepartmental government planning committee for the national nutrition program, a program then in contemplation as a part of the defense activities, and Surgeon General Parran of the Public Health Service, had become deeply interested in the possibility of improving white flour. Both of them for many years had recognized the importance of the white bread problem. At their instigation, then, the executive officers of national associations of millers and bakers called a very informal meeting in Chi-

*A note in "Science," December 20, 1940, p. 576: "The British Ministry of Food announces that the Flour (Vitaminisation) Advisory Committee will have the assistance of Professor D. S. M. Watson of the Scientific Subcommittee of the Food Policy Committee of the Cabinet, of P. N. R. Butcher of the Ministry of Health and of the following officers of the Ministry of Food: Sir Norman Vernon, director of flour milling; Professor J. C. Drummond and some others."

ago, which was attended by several leaders in these and allied industries, as well as by a number of invited physicians and scientists in government and out. Among the latter were Doctors Spies, Boudreau, Nelson, Stanley, Sebrell, Roberts and Williams. This was the meeting of which de Kruif wrote so brilliantly in an article published in Reader's Digest. The subject received additional consideration at a number of other conferences, and at general meetings held by the American Institute of Baking, the American Bakers Association, and the Millers National Federation. As a result, when the public hearings on flour were reopened by the Food and Drug Administration in mid-November, industry, science and government were thinking together as they had not been able to do before, and a harmony of opinion had been obtained which was most encouraging.

Action of the Committee on Food and Nutrition of the National Research Council

IN LATE NOVEMBER came the first meeting of the newly appointed Committee on Food and Nutrition of the National Research Council, a committee composed of nearly thirty people who represented leading scientific thought in nutrition in the United States. This committee endorsed the recommendations relating to vitamin and mineral additions to flour, which had been proposed in the final public hearings by several members of this scientific group, and by

representatives of the millers and bakers. At the same meeting of the Committee on Food and Nutrition, a subcommittee was appointed to study the development of related standards for bread. The recommendations of this subcommittee were adopted subsequently by the main committee. In their preparation Mr. Schumaker, President of the American Bakers Association, Dr. Tobey, Director, Department of Nutrition, of the American Institute of Baking, and Mr. Thomas, all representing the interests of the millers and bakers, co-operated with Dr. Nelson of the Food and Drug Administration, Dr. Sebrell of the United States Public Health Service, and Dr. R. R. Williams, members of the subcommittee.

The standards for bread were designed so that the advantages of an improved flour could be carried over to bread, and so that a baker using the new flour could automatically produce a bread with comparable nutritional improvement. At the same time it was recognized that the baker had at his disposal other methods for incorporating the desired vitamins and minerals in his loaf.

About this time word was received from the Food and Drug Administration that on the basis of testimony presented at the hearings on flour the legal advisors of the administration had expressed a preference for the name "enriched" for the proposed flour, and for bread which complied with related nutritional standards; also that if this name was acceptable

to the committee of the National Research Council and to the industries it would be appropriate to start manufacture and distribution of the new products, enriched flour and enriched bread, without waiting for the promulgation of formal regulations.

The question of a name for the products had previously aroused much discussion. The industries had favored a coined word that could be copyrighted. The committee had wanted a designation which would indicate the nature and direction of the change made in plain white flour and white bread. The name "enriched" was acceptable to the committee, and the industries, after meetings of their executive officers and directive boards, graciously agreed.

Thus, on January 29, 1941, it was possible for the National Research Council to announce agreement on specifications and name for nutritionally improved flours and breads that had the approval of its Committee on Food and Nutrition. The approval of the Council on Foods and Nutrition of the American Medical Association had previously been obtained, as had that of the Millers' National Federation and the American Bakers Association. In the news release that was prepared, announcement also could be made that these national organizations had agreed to start production of enriched flour and enriched bread without delay. The industries, soon afterward, further indicated their support by agreeing between themselves to establish an agency to

co-ordinate the advertising of enriched flour and enriched bread with the general national program of health welfare, nutrition and allied activities, headed by Governor Paul V. McNutt. Mr. Paul Cornell, past-chairman of the Board of the Associated American Advertising Agencies, who is eminently qualified for such a responsibility, has been selected for this important post.

Enriched flour and enriched bread, according to the specifications recommended by the Committee on Food and Nutrition, are to contain thiamine, nicotinic acid and iron in amounts as prescribed in milligrams per pound. These amounts approximate those that would be found in a flour obtained by extracting 85 per cent of wheat of high vitamin quality, or respectively in a bread made with such flour. Riboflavin in a specified amount is made an optional ingredient for both flour and bread preceding receipt of assurance that an adequate supply of it has become available. Calcium, phosphorus and vitamin D may be added at the option of the miller or baker, with prescribed limitations as to amounts.*

*The recommended specifications for enriched flour call for the following per pound of flour: thiamine 1.66 mg. nicotinic acid or nicotinic acid amide 6.15 mg., and iron 6.15 mg. Riboflavin is to be included in the specifications as soon as it can be shown that sufficient supplies of riboflavin are available. In the meantime, its inclusion is permitted as an optional ingredient if added in such amounts as

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This program seriously involves large and very important industries. Conflict of interests might have been anticipated. Nevertheless, the program is backed by more complete agreement between these industries, government and experts in nutrition-

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are necessary to make the level in the flour, per pound, 1.22 mg. Other optional ingredients permitted are calcium, phosphorus and vitamin D to minimal levels of .05 gm., 0.5 gm. and 250 International units respectively. The specifications for enriched bread correspond to those for enriched flour to the extent that bread made using only enriched flour, yeast and water will be enriched bread. However, the enriched bread may be made from plain white flour by employing other available methods for incorporating the specified vitamins and minerals. The completed bread per pound must contain thiamine 1 mg., nicotinic acid or nicotinic acid amide 4.0 mg. and iron 4 mg., with riboflavin optional for the time being at a level of 0.8 mg. and calcium and vitamin D optional ingredients at minimal levels, respectively, of 0.3 gm. and 150 International units. Maximal levels are named for all of these factors.

al science than ever could have been obtained by a less democratic procedure. The decisions at which we have arrived are of the greatest importance, and all the many who have been devoting their time and effort to bring about this general agreement have reason to be pleased. We have contributed by example to the triumph of the American way in government, and are in position now to greatly improve national nutrition, and through it the national welfare. Edwin Grant Conklin, emeritus Professor of Biology at Princeton University, once said: "The ethics of science . . . considers service of mankind to be the universal good; it teaches that both human nature and human nurture may be improved; that reason may overcome unreason, co-operation supplement competition and the progress of the human race through future ages be prompted by human intelligence and purpose." This is the scientific course upon which those who are engaged in improving the Nation's diet have cooperatively embarked.

*Public Health Aspects of Enriched Flour and Bread**

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AS A PHYSICIAN and a health officer I am vitally interested in the health of the people of this country. The enriched flour and bread program is one of major importance in accomplishing something constructive to meet the serious dietary deficiencies

which exist in this country today. Many of you may think that the American public is well-fed. As a matter of fact all of the recent dietary studies made in this country indicate very clearly that a large part of our people are getting diets which are below the standards necessary to maintain health. It has been reliably estimated that not less than one-third of our entire population are getting diets which are not entirely adequate.

DR. W. H. SEBRELL, at age 39, has already achieved international recognition for his research work on nutrition. His work on pellegra in 1928, as assistant to famed Dr. Goldberger, gave him an early interest in deficiency diseases. Shortly after graduation from the University of Virginia's Medical School, Dr. Sebrell became associated with the United States Public Health Service, where he has spent his entire career to date. In 1933 he was placed in charge of Nutritional Studies in the Public Health Service and has written innumerable scientific papers and reports on nutrition. A Fellow of the American Public Health Association, Treasurer of the American Institute of Nutrition, a member of the American Society of Biological Chemists, Dr. Sebrell has specialized in both the public and scientific sides of nutrition. As Surgeon, U. S. Public Health Service, he is a Federal representative on the National Research Council's Committee on Food and Nutrition.

Another misconception which some of you may have is that the inadequate diets in this country are found entirely in the lowest income groups. While it is true that *most* of the inadequate diets are found in this group, it has been found that inadequate diets also extend into the highest income group. Many of you in this audience are probably eating inadequate diets, not from inadequate incomes, but from poor food selection, special diets or lack of knowledge as to what you should eat. I have seen actual deficiency diseases in well-to-do business and professional people simply because they had neglected their diets as most of us are inclined to do. They

**Read at the conference of bakers, millers and others to co-ordinate the introduction of enriched flour and enriched bread, Chicago, March 5, 1941*

eat what they want to eat and not what they need.

American diets are most likely to be deficient in some of the vitamins and minerals in spite of the large increase in the consumption of fruits, vegetables and milk in this country in recent years. For many years many different agencies in this country have been attempting through educational means to improve the American diet. It may surprise some of you to learn that the American diet is more deficient in thiamine, which is one of the vitamins of the B complex, than was the American diet of 100 years ago. Some of you may have felt that the increased consumption of fruits, vegetables, and milk has been one of the causes of the decreased consumption of flour and bread. I do not believe that this is true. One of the major causes for the decreased consumption of flour and bread in this country may be one which you have not considered very seriously or may have thought did not amount to very much, that is the fact that dietitians, home economists, colleges of home economics, and all the institutions in this country that are teaching nutrition have taught, and under present conditions must continue to teach, that white flour is practically devoid of minerals and vitamins, and that in obtaining an adequate diet one must be sure to get the necessary vitamins and minerals first from other sources and then complete the diet with any foods that suit the appetite — including white flour and white bread.

Diet and the physician

PHYSICIANS have to do just that in making special therapeutic diets. When I have to make a special diet I must first assure the vitamin and mineral intake; having secured that I can then consider the protein, fat and carbohydrates and then I can say eat enough white bread to make up your calories if you care to do so. This sort of thing has been going on for years.

In addition, whenever you hear anyone talking about reducing diets, which are so popular with the ladies these days, you almost invariably hear them advise a decreased consumption in flour and bread. This situation has been brought about by the highly refined milling processes which have made white flour such a beautiful product to look at but which have so seriously injured its nutritive value compared with the original wheat from which it is made. I do not blame the millers for making a highly refined flour. As I see it you men in industry are trying to give the public what it wants. The fault has been that the public did not want the right thing and I think we have to educate the public to want a flour and bread of high nutritive value.

The tendency of the American public to use highly refined foods has been manifested in other ways than in flour. I wonder if you realize that if you add together the calories consumed in the average diet from white flour, refined sugar, and highly refined fats you find that these items make up more than half of the indi-

vidual's average daily calorie consumption. As a result he must get all of his minerals and vitamins from the remaining 1,000 calories or so which make up his diet and this is the reason that our diets today are more deficient in thiamine than they were in the past. The increased vitamins and minerals supplied by fruits and vegetables are not enough to make up for the loss which has occurred in eating more highly refined foods of other types. It is factors such as these, which taken together with poor food selection and low incomes, are the major causes of the widespread dietary deficiencies existing in this country today, and I cannot over-emphasize the importance of these things from the point of view of preventive medicine.

A new concept has arisen in preventive medicine in the past few years. You no doubt think of preventive medicine as vaccination against smallpox, immunization against diphtheria, and sanitation of water and sewage. Today preventive medicine has advanced beyond that view. The up-to-date health officer is now concerned with building the healthiest possible population with the greatest resistance to disease. A major part of such a program is that the population shall receive a diet adequate in all respects. For this reason the widespread prevalence of deficient diets is of serious concern to the health officer and these dietary deficiencies and means for their prevention are now being studied in considerable detail.

B-vitamin and iron deficiencies

IT is recognized that the most prevalent deficiencies in this country today are those due to deficiencies in members of the vitamin B complex and in iron. I have no intention of giving you a dissertation on the diseases produced by these deficiencies but there are a few facts with which any well informed persons should be familiar. The three members of the B complex which are most important from a health point of view in this country are thiamine, riboflavin and nicotinic acid.

Thiamine deficiency in its extreme form causes a disease known as beriberi. This was formerly thought to be a tropical disease which did not occur in the United States. We now know that this is not the case. We see many cases of severe beriberi and we recognize that a condition known as peripheral neuritis which occurs in cases of pregnancy and in alcoholics, as well as in other diseases, is also a manifestation of thiamine deficiency which was not recognized a few years ago. But from the point of view of the entire population, even more important than these serious deficiencies has been the very recent recognition that thiamine deficiency also causes symptoms such as mental depression, easy fatigue, and undue anxieties and although the individuals with these symptoms are not sick in the sense that they do not go to bed, these things result in a lowered efficiency and possibly other more serious eco-

conomic consequences. There is every reason to believe that these symptoms are widely prevalent in this country because of our reduced thiamine intake.

The symptoms of riboflavin deficiency were just recognized about two years ago. This condition is manifested by fissures in corners of the mouth, a scaly condition around the nose and ears and disturbance in vision caused by blood vessels growing into the cornea of the eye which obscures the vision and may lead to blindness. These symptoms miraculously disappear on the addition of riboflavin to the diet. Although this disease has been recognized only so recently it is evident now that it also is widespread in this country.

The importance of riboflavin is further evidenced by the fact that it is found in every living cell, at least in all the higher forms of life, and when experimental animals are deprived of it they invariably die as is also the case with most of the other vitamins.

Nicotinic acid deficiency leads to a disease known as pellagra which was formerly thought to be confined largely to the southern United States. We now know that it exists throughout the United States. The symptoms of pellagra have been known and recognized for a long time and I do not believe it would be an exaggeration to say that not less than 200,000 cases occurred in this country last year. The disease kills more than 3,000 people in this country each year. Yet it can be entirely prevented by nicotinic acid

which is one of the members of the vitamin B complex.

It has been known for only a few years that nicotinic acid will prevent pellagra. When I use the words "nicotinic acid" I know most of you immediately think of nicotine. It is most unfortunate that the name of the deadly poison nicotine sounds so similar to the name of this life-saving vitamin "nicotinic acid" which is found so widely in our daily foods. This unfortunate similarity is due to the fact that although nicotinic acid was made in the laboratory in 1867 no one found any practical use for the substance until to everyone's astonishment it was discovered in 1937 that it would prevent and cure pellagra a disease for which we had previously had no specific treatment. It may interest you to know that all during the years when I was searching for the pellagra-preventive vitamin I had a bottle of this same nicotinic acid sitting on the laboratory shelf—never suspecting that what I was seeking was standing at my elbow.

More important than the above symptoms, however, from the point of view of numbers of people involved, is that there were many thousands who had red tongues and suffered from indigestion and weakness due to a partial deficiency in this substance. In addition, there is an acute mental condition characterized by confusion and disorientation which is due to nicotinic acid deficiency.

Another point of considerable interest about these various diseases is that they are rarely found alone. We usually see an individual with symptoms of two or all three deficiencies at the same time. This is not surprising since these three factors of the vitamin B complex are usually found in the same foods. An individual does not select a diet that is deficient in just one of these things. Since his deficient diet is due to the absence of natural foods containing these vitamins the diet is likely to be deficient in the entire B complex rather than in just one of the factors, and in order to prevent the development of these deficiencies it is necessary to supply all of these factors as they would be supplied by natural foods.

One of the most important of the mineral elements for the human body is iron. Iron is necessary for the formation of the hemoglobin of the blood and if there is an insufficient amount of iron in the diet an anemia develops. Individuals living on foods raised on soils which are deficient in iron develop anemias, and school children have been found in this country with about one-half of the amount of hemoglobin in their blood that they should have simply because their food did not contain enough iron. These sickly, weak, undernourished, and frail children can never be any better until this iron deficiency is corrected. Identical conditions develop whenever the diet is deficient in iron

for any cause, whether it be because the foods are raised on iron deficient soils or because the iron has been removed from the food by milling or other processing.

Food vs. pills

THERE are other deficiency diseases in the United States in addition to the above, however, from a public health point of view they do not cause the deaths, the illnesses and the economic loss which are caused by the above. Therefore, we are directing our attention to devising a program which will solve once and for all the problem of continuously getting into the American diet enough thiamine, enough riboflavin, enough nicotinic acid and enough iron to prevent the development of these deficiencies. I feel that the proper way to approach this problem is through dietary means and not through the use of vitamin pills or tablets. These conditions have developed as a result of our improper handling of foods and should be corrected by changing the handling of our foods so that the vitamin and mineral content is restored to a level which will be effective for this purpose.

There is no intention to make bread or flour a medicine. We are not attempting to treat disease—that is in the province of the physician. We are attempting to prevent disease and to prevent the disease conditions which we have brought down on our own heads through improper food

practices and which should be, and can be corrected, by making suitable changes in our food habits. Just a few years ago I took the point of view that the way to correct these conditions was to try to stimulate the increased consumption of foods naturally high in these vitamins. I still think that this point of view is correct theoretically. Although I recognize that such a program if it succeeds at all will progress so slowly that it cannot meet the extensive deficiency conditions in our population today; therefore, as I see it the next best thing is to add these vitamins and minerals to foods which are consumed in large quantities especially by the low income groups.

We already have one example of this in the various forms of vitamin D milk that are now widely used in this country. Some of these products were introduced about ten years ago in an effort to solve our rickets problem, and today it is recognized that they are of the utmost value in the prevention of rickets. They have added very little to the cost of milk and yet are one of our best and most economical means of preventing rickets.

A stronger staff of life

BREAD has always been the mainstay and principal component of the poor man's diet. The fact that it has become nutritionally inferior has taken away these vitamins and minerals from the very population groups which need them most. I feel that the addition of thiamine, riboflavin,

nicotinic acid, and iron to flour and bread in sufficient quantities will represent a major contribution towards solving our dietary deficiency problem. There is great public interest in this subject at the present time. This public interest should be utilized and guided on a national scale in the right direction so that the public will obtain a product which will be of real health significance.

It is of equal importance that the public shall not be misinformed or misled. They should be reassured that they are receiving a food and not a medicine. The industry must take on itself the preparation and regulation of product for which you yourselves will permit no unsubstantiated claims. It is equally important that these enriched flours and breads shall reach the public at the lowest possible price. From a public health point of view it is most important to reach the lowest economic groups, and a premium price product is likely to be beyond their reach.

Again from a health point of view, it is of little importance how the necessary levels of vitamins and minerals are obtained in the flour and bread. The important thing is that the necessary substances are there in the final product in a quantity sufficient to be of value. And I would like to see this accomplished in the most economical way possible. I hope we will see these levels obtained in a variety of ways to meet a variety of tastes so that it will have the widest pos-

sible utilization. There is no reason why we should not have white flour to which the synthetic materials have been added, a lightly milled, creamy colored flour, and a dark flour with the vitamins and minerals retained by the milling process, and also that we shall have a variety of breads of various colors and flavors just so the vitamins and minerals are there. As far as I am concerned, I just want to know that the individual who is on a deficient diet gets into his stomach these things in the quantities in which he needs them and it is up to you gentlemen to get them to him in the best possible way.

Various nutritional programs have been tried in the past in an effort to solve our dietary deficiency problems. We have seen years of effort spent in an attempt to get people to eat whole wheat bread. I think we all recognize that this program has been definitely a failure. It has not solved the problem. Too many people still demand white flour and white bread, and I think we should give it to them as long as they demand it but also give them an opportunity to have their vitamins and minerals concealed in this product if they must have it that way.

As I have indicated, our deficiency problem is one of multiple deficiencies, therefore, the addition of thiamine alone is not sufficient. We have seen in recent months a number of breads appear on the American market which have been fortified with

thiamine and these breads have been advertised as being a superior product on this account. This is not enough. We frequently see cases of thiamine deficiency which go on and develop symptoms of nicotinic acid deficiency or riboflavin deficiency. The addition of thiamine is only a partial answer to the problem. Just as the addition of nicotinic acid or of thiamine and nicotinic acid would constitute only a partial solution to the problem. We need to put back into the flour vitamins which were originally present in the wheat, not just some of them, or you will still leave us with thousands of sick people. I want to remind you again that as a physician interested in public health I am also interested in solving this problem and that means the addition of all of the substances I have mentioned today. If we can make such an enriched flour and bread available we should be able to change our teaching practices and our educational activities in regard to the use of this flour and bread instead of having to relegate these items to the groups of foods which fail to supply many vitamins and minerals. Nutritionists and dietitians will be able to recommend them and utilize them in preparing adequate diets and I think the leaders in nutrition education in this country would welcome such an opportunity to utilize such an important element in our diet instead of having to tell a poor family that they must buy more expensive foods in order to get their necessary vitamins and

minerals. It is much simpler to tell that family to shift to enriched flour and bread. I hope to see this enriched flour and bread promoted in a conservative educational manner on the basis of its value as a contribution to a health preserving diet, and as a permanent program sold to the population on the basis of this value and with no promotional flash in the pan hysteria. If this is to be of any value it must be a *permanent* change in the American dietary and should be approached from that point of view. It is imperative that we have cooperative action between all of the agencies concerned. If an educational campaign is undertaken by health or other authorities before the flour and bread are ready commercially it will be just so much wasted effort. If the various

baking and milling companies undertake industrial campaigns without co-operation and without proper advice in regard to their advertising, exaggerated and unwarranted claims may nullify much of the work of the program.

I feel that here is a real opportunity for a great American food industry to carry on a program which will result in a permanent and valuable contribution to the health of this nation, and at the same time benefit our agriculture by increasing the proper utilization of one of our most valuable and economical foodstuffs.

Eagerly we look forward to the day when our children and our children's children will be armed with the armor of robust health.

